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Research Article

Evaluation of the Sodium Diet in Hypertensive Patients Followed in Brazzaville (Republic of Congo)

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Summary

Objective: Achieving optimal blood pressure control through adherence to a low-salt diet would reduce the occurrence of complications of hypertension. The aim of this study was to assess compliance with a low-salt diet in hypertensive patients undergoing outpatient treatment in Brazzaville.

Patient and Method: We conducted a cross-sectional analytical study of 363 hypertensive patients undergoing treatment and followed up as outpatients in 03 major hospitals in Brazzaville from 1er April to 30 October 2023. The data evaluated were: compliance with drug treatment using the Girerd test; low-salt diet using the Exsel test and 24-hour natriuresis. Statistical analysis was performed using SPSS 25 software.

Results: We recruited 363 hypertensive patients; the sex ratio M/F was 0.56 with a predominance of patients aged 60 to 75 years. With regard to drug treatment, calcium channel blockers were the most common class of antihypertensive drugs used by 68.9% of patients, and 26.7% of them had poor compliance with their drug treatment. Estimated mean 24-hour natriuresis was 20 ± 26.7 g/d. Six patients had a recommended salt intake (<6g/d), 50 patients had a normosodium diet (13.8%) and 307 patients (84.6%) had an excessive salt intake.

Conclusion: Compliance with the low-salt diet is poor in hypertensive outpatients in Brazzaville. Therapeutic education sessions should be intensified to improve patients' knowledge of the low-salt diet.

Keywords: Hypertension; Salt Diet; Brazzaville

Introduction

Hypertension is a major cardiovascular risk factor and a major public health problem worldwide. It affects all socio-professional groups and is unequally distributed across continents and countries, with a growing prevalence in developing countries. It is thought to be responsible for around 13% of deaths worldwide [1]. It is estimated that around 1.39 billion people aged between 30 and 79 suffer from hypertension, three quarters (3/4) of whom live in developing countries [2]. This figure is set to rise further as the population ages. In the USA, the prevalence of hypertension exceeds 80%; it is estimated at 67% in Germany and 55.5% in France [3]. In Africa, its prevalence is estimated at 33.6% in Morocco [4] 40.8% in Senegal [5]. In Congo, the STEPS survey carried out in Brazzaville in 2004 revealed a prevalence of 32.5% in the general population [6]. A more recent study carried out in 2017 in the general population of Brazzaville showed a prevalence of 41.0% [7].

Hypertension is the result of a combination of genetic and environmental factors, and adopting a healthy lifestyle and a balanced diet can help to improve its management [7]. Among the major lifestyle changes that can help achieve blood pressure control is a low-salt diet [8]. The low-salt diet is a therapeutic method that has shown spectacular improvement in blood pressure control and represents one of the main weapons for avoiding the dramatic complications of hypertension and its consequences [9].

The link between sodium and the development of hypertension is undoubtedly the best established. Indeed, numerous studies have demonstrated the role of sodium not only in the regulation of blood pressure but also in the pathophysiology of hypertension [9-11]. However, over the course of human evolution, salt consumption has steadily increased [12]. In European countries, the average salt intake of the general population is around 10 g/day [10,12]. In Africa, a systematic review of the monitoring and implementation of salt reduction initiatives revealed that salt intake in the African adult population ranged from 6.8g to 16.7g/day, and that only South Africa had implemented strategies to reduce salt consumption [12]. The World Health Organisation (WHO) recommends that hypertensive patients consume less than 6g of salt per day [13].

In the Republic of Congo, there is little scientific data on average salt consumption in the general population, or in hypertensive patients. Although practitioners recommend a low-salt diet for hypertensive patients, compliance has never been effectively evaluated. Hence the interest of our work, the general objective of which is to evaluate compliance with the lowsalt diet in hypertensive patients followed in Brazzaville. Specifically, the study aims to

- To describe the socio-demographic profiles of hypertensive patients followed up on an outpatient basis in Brazzaville;
- To determine the frequency of non-compliance with the low-salt diet in hypertensive patients followed as outpatients in Brazzaville and;
- To identify the factors associated with compliance with a low-salt diet in hypertensive patients undergoing outpatient treatment in Brazzaville

Patients and Methods

This was an analytical cross-sectional study running from 1er April to 30 October 2023, i.e. 7 months.

Our study took place in Brazzaville, the capital of the Republic of Congo, in three (3) hospitals, namely the University Hospital center of Brazzaville (UHC-B), the Talangaï and Makélékélé referral hospitals.

The departments involved were: the outpatient department at CHU-B, the general medicine and cardiology departments at the Talangaï referral hospital, and the internal medicine department at the Makélékélé referral hospital.

The general population consisted of hypertensive patients. The target population consisted of treated hypertensive patients placed on a low-salt diet. The source population consisted of hypertensive patients followed as outpatients at UHC-B and the Talangaï and Makélékélé referral hospitals.

We included hypertensive patients in the study

- Aged 30 and over;
- Able to answer the questionnaire;
- Follow-up in the hospitals selected for the study;
- who freely agreed to take part in our study.
- Patients were not included:
- known chronic renal failure at KDIGO stages 3A, 3B, 4 and 5 [14]
- with secondary hypertension; - on diuretics for less than 6 weeks
- pregnant women.

- Simple probability sampling of patients who met the inclusion criteria during the study period.
- The minimum patient sample size was calculated using the Schwartz formula.
- This gives a minimum size of 372 patients.

During our study, we recruited 435 patients, but only 363 patients who met the selection criteria were definitively included, representing 2.4% fewer than the calculated size. Of the 363 patients included, 232 were being treated at UHC-B, 98 at the Talangaï referral hospital and 33 at the Makélékélé referral hospital. The figure 1 show the step-by-step process of selecting the study population.

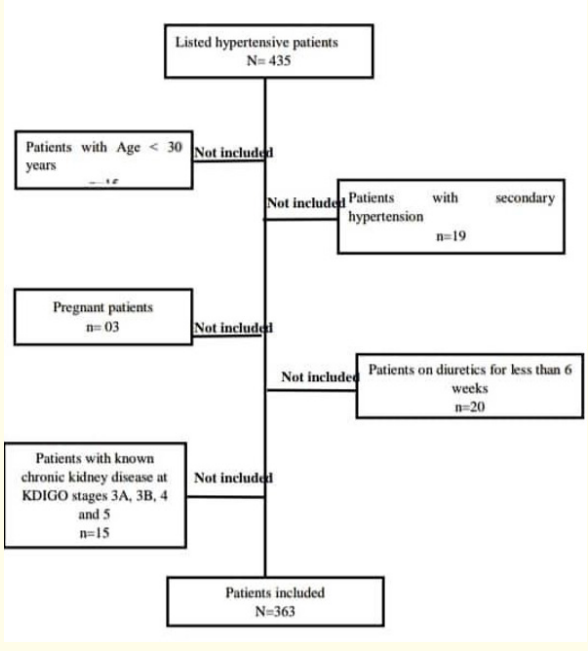

Figure 1: Patient selection diagram.

An anonymous survey form (Appendix 1), formulated in simple terms, was submitted to the patients in the various hospitals selected. The form was filled in by the interviewer.

Data collection method; a face-to-face interview between interviewer and respondent, measurement of anthropometric, clinical and biological parameters. Collection tools.

The data collection tool was tested and adjusted before data collection began. We administered the questionnaires and collected anthropometric, clinical and biological data.

The study was carried out in four (4) phases

1st phase: administrative phase

The various managers of the selected hospitals were visited in order to present them with the certificate issued by the Faculty of Health Sciences, approved by the Health Science Research Ethics Committee (CERSSA). The purpose of the survey and the practicalities of carrying it out were explained.

2nd phase: data collection phase

Data collection took place over 7 months. Patients were recruited exhaustively from the various hospitals selected, taking into account inclusion and non-inclusion criteria.

Data was collected using a pre-established questionnaire written in French (Appendix I) after obtaining informed consent from the patients. The data were collected in two stages: the patients were seated in a private consultation room to ensure a pleasant atmosphere and to protect their privacy, followed by an individual interview to collect socio-demographic characteristics, medical history, and assessment of compliance with antihypertensive treatment using the Girerd therapeutic compliance score [15].

Blood pressure (BP) was measured in a seated patient, front on the table, with the cuff adapted to the diameter and length of the arm. The protocol consisted of three (3) blood pressure measurements. BP was measured after a ten-minute rest in seated patients. Blood pressure was taken by one and the same investigator for each patient, using the same blood pressure monitor. The BP value used was the average of the three measurements.

The weight was recorded on a mechanical scale, with the subject standing, without shoes and without any load. Waist measurements were taken standing, without shoes, using a device attached to a wall support. Waist circumference was measured standing with the subject unclothed.

3rd phase: blood and urine sampling phase

The patients who answered the various study questions were then contacted by telephone 48 hours before the blood sampling in order to explain the 24-hour urine sampling method and the geographical location of the sampling site. Blood samples for creatinine levels were taken in the procedure room of the nephrology department of UHC-B.

The 24-hour urine collection procedure was as follows: the subject emptied his bladder at a set time and the urine collected was discarded. From this point onwards, all the urine emitted during the 24 hours was collected in a container of sufficient capacity, usually two litres. The urine was stored at room temperature. The last urine collection took place the following day at the same time, keeping the urine from the first micturition after waking up. The urine was collected without preservatives or acidification.

4th phase: behaviour change communication phase

Once the biological results had been obtained by the principal investigator, the patients were contacted again to provide a copy of their results and advice on the low-salt diet. In particular, they were advised to reduce their consumption of rusk and Viennese pastries, cheese, cold meats, foods rich in hidden salt and to stop using bouillon cubes or powdered flavour enhancers. Hypertensive patients were also asked to stop eating bread rich in salt in favour of wholemeal bread (low in salt).

This study took into account : the following socio-demographic variables (age, gender, marital status, socio-economic level, level of education); the clinical variables (the speciality of the attending physician, patient followed by a dietician, stroke, heart disease, smoking, alcoholism and kidney failure, systolic blood pressure (SBP), diastolic blood pressure (DBP), anthropometric parameters (weight, height, body mass index (BMI), abdominal circumference),, the number and types of antihypertensive drugs taken by the patient, therapeutic compliance, the daily dietary salt intake; the following paraclinical variables: creatinemia, calculated daily salt intake.

To calculate the daily amount of salt consumed by each patient, we used the 24-hour Natriuresis.

Natriuresis [13,16,17]

The 24-hour urine was diluted 1/2éme with distilled water. The results obtained were multiplied by 2 (dilution factor). The method was based on modifications of those described by Tinder in which sodium is precipitated with uranyl Mg-acetate to form triple salts; sodium magnesium uranyl acetate. The excess uranyl ions react with thioglycol acid, producing a chromophore whose absorbance varies inversely with the concentration of sodium in the test sample. The results obtained were expressed in mmol/l. Once the 24-hour natriuresis result has been obtained in mmol/24h, it is divided by 17 to obtain the amount of salt consumed in g/24h (1g NaCl = 17 mmol Na).

The WHO's recommendations for clinical practice is a daily salt intake of less than 6g/24 hours. This is equivalent to a recommended Natriuresis of less than 106 mmol/24 hours. Creatinemia levels were measured to assess the stage of chronic kidney disease in the hypertensive patients in our study.

The therapeutic compliance was evalued with Girerd compliance score [15,18].

Main concepts and operational definitions

Low-salt diet: diet containing 4 to 6g of salt per day [19]. Salt-free diet: lifestyle or dietary habit providing less than 4 g of salt per day [19]. Normo sodium diet: lifestyle or dietary habit providing 6 to 8g of salt per day [19]. High salt diet: dietary pattern or habit providing 8 to 11g of salt per day [19]. Excessive salt consumption: richly salted food habit containing 12g or more of salt per day [16].

Arterial hypertension: defined as systolic blood pressure ≥ 140 mmHg and/or diastolic blood pressure ≥ 90 mmHg or on antihypertensive treatment.

It is considered to be controlled for levels below 140/90 mmHg in non-diabetics patients, and below 130/80 mmHg in diabetics or those with renal failure [20] based on an average of three measurements.

Obesity was defined by BMIBMI ≥ 30 kg/m^2.[22].

The Staging chronic kidney disease was based on the glomerular filtration rate (GFR), calculated using the MDRD formula and the KDIGO 2012 recommendations.

Data analysis

The data was entered using the Android application Kobo Collect. The data was then exported to Excel for processing. Statistical analyses were carried out using SPSS 25 software. Once the data had been sorted, the qualitative variables were presented in tables with absolute and relative numbers, while the quantitative variables were calculated with trend (mean, median) and dispersion (standard deviation) parameters.

For comparison purposes, the chi-square test was used for percentages and Student's t-test for means. The significance level was set at $p < 0.05$.

To identify the factors associated with 24-hour natriuresis, a univariate analysis was performed, cross-tabulating the variable of interest with the explanatory variables (sociodemographic, specific, clinical and therapeutic characteristics). Following this analysis, a multivariate analysis was performed, including all variables with p-values below the 5% significance level in a logistic regression model. Only the final model is presented in this study. Odds ratios (OR) with their 95% confidence intervals (CI) were calculated. The significance level was set at $P < 0.05$. The odds ratio (OR) with 95% confidence interval (CI) were reported to obtain the risk relationship.

Results

Socio-demographic characteristics

The mean age was 60.6 ± 24.9 years, with extremes of 30 and 88 years. The sex ratio was 0.56. The distribution of patients by age, gender and marital status is shown in Table 1.

Variables	Workforce	%
Age groups 30-45	56	15,4
46-59	119	32,8
60-75	154	42,4
≥75	34	9,4
Type Men	131	36,1
Woman	232	63,9
Marital status Single	82	22,6
Married	137	37,7
Common-law union	55	15,2
Divorced	18	4,9
Widow(er)	71	19,6
Total	363	100

Table 1: Socio-demographic characteristics of patients (N = 363).

Level of education

120 patients (33.1%) had a higher level of education. Figure 2 shows the distribution of patients by education level.

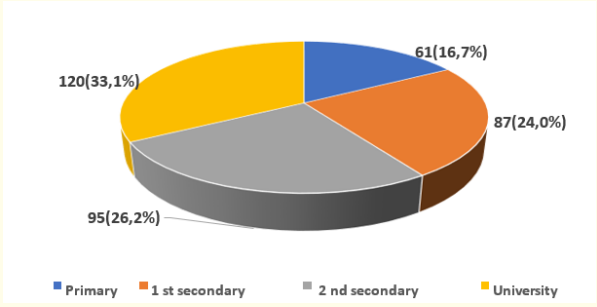

Figure 2: Distribution of patients by level of education.

Socio-economic level

Of the 363 hypertensive patients, 222 had an average socio-economic level (61.2%). *Figure 3* shows the distribution of patients by socio-economic level.

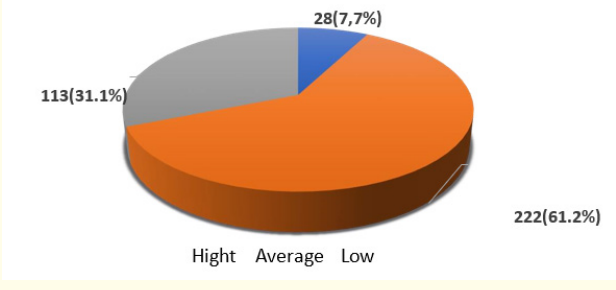

Figure 3: Breakdown of patients by socio-economic level.

Clinical characteristics clinical history

associated comorbidities 119 hypertensive patients (32.8%) consumed alcohol. Table 2 shows the patients' comorbidities.

Comorbidities	Workforce	%
Diabetes	93	25,6
Heart disease	35	9,6
Stroke	83	22,9
Smoking	10	2,8
Alcoholism	119	32,8
Hight Blood Pressure isolated	23	6,3
Total	363	100

Table 2: Distribution of patients according to associated comorbidities (N = 363).

Duration of hypertension

The mean duration of hypertension was 12 ± 6 years (min: 3 years max = 20 years).

Blood pressure control

Mean PAS was 147.6 ± 25 mm Hg (range: 90 to 210 mm Hg). The mean DBP was 65.6 ±20 mm Hg (extremes: 45 and 131 mm Hg). 133 patients (36.6%) had controlled hypertension and 230 patients (63.4%) had uncontrolled hypertension**.**

Body mass index

The mean BMI was 27.4 ± 6.0 kg/m2 with extremes ranging from 12.5 to 49.2 kg/m2. We found 120 obese patients (33.1%).

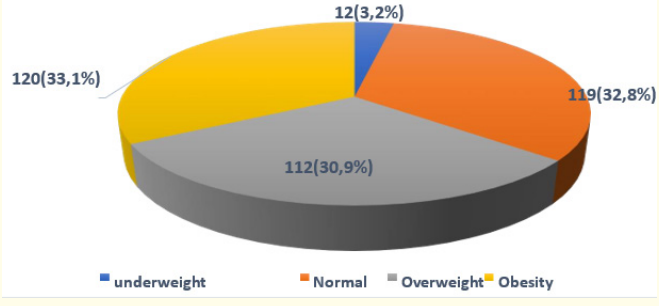

Figure 4: Distribution of patients according to BMI.

Patient treatment and follow-up

Of the 363 hypertensive patients, 187 were being followed by a cardiologist (51.5%); 191 were taking monotherapy (52.6%); 250 were taking calcium channel blockers (68.9%) and 8 were being followed by a dietician (2.2%). Table XV shows the distribution of patients according to the specialty of the treating physician, the number of antihypertensive drugs taken and the antihypertensive drugs taken.

Therapeutic compliance

The study found that 24.3% of patients had good compliance, 49% had minimal compliance problems and 26.7% were poorly compliant.

Variables	n	N = 363 %
Doctor's speciality Cardiology	187	51,5
Neurology	60	16,5
Endocrinology	44	12,1
Nephrology	32	8,8
Rheumatology	30	8,3
Geriatrics	2	0,6
Internal medicine	6	1,6
General medicine	2	0,6
Follow-up by a dietician Yes	12	3,3
No	351	96,7
Classes of antihypertensives Calcium inhibitors	250	68,9
IEC	142	39,1
ARA2	58	16,0
Thiazide diuretics	114	31,1
Beta-blockers	19	5,2
Central antihypertensive agents	2	0,6

Table 3: Medical specialties of treating physicians and antihypertensive drugs in hypertensive patients.

Assessing salt consumption

-Mean 24-hour natriuresis was 372.3±284 mmol/24h with extremes of 68 mmol/24h and 1173 mmol/24h. By converting the 24-hour natriuresis into salt consumption per g/day, we found a daily average of 21.9 ± 16.7 g of salt, with extremes ranging from 4 to 69 g/day.

Natriuresis ≥ 200 mmol/24h (equivalent to salt consumption of 12 g/day or more) was found in 291 patients (80.2%).

Natriuresis < 106 mmol/24 h (equivalent to salt consumption < 6 g/day) was found in 6 patients (1.6%).

The distribution of patients according to their salt diet is shown in figure 5.

Patients aged between 60 and 75 (n = 122) had a higher salt intake than other age groups (33.6%).

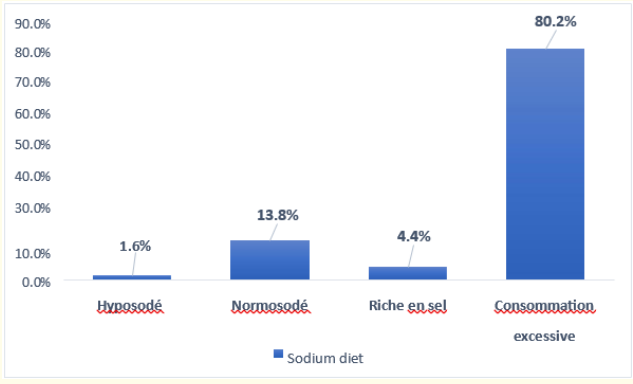

Figure 5: Distribution of patients according to sodium diet.

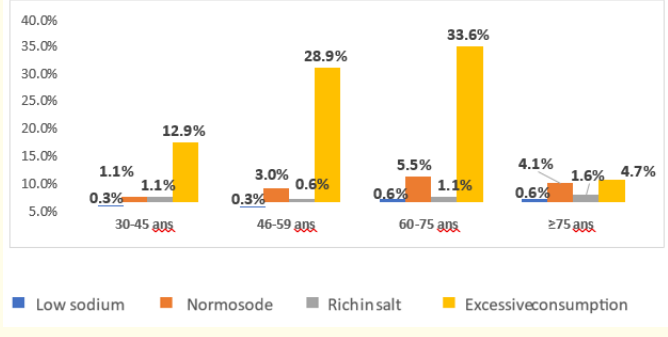

Figure 6: Breakdown of patients by age group and sodium diet.

The distribution of patients according to sodium intake and level of education shows that all patients, regardless of their level of education, consume excessive amounts of salt, especially those with higher education (n = 86) and secondary level 1er (n = 80), representing 23.7% and 2.0% respectively. *Figure 7* illustrates these findings.

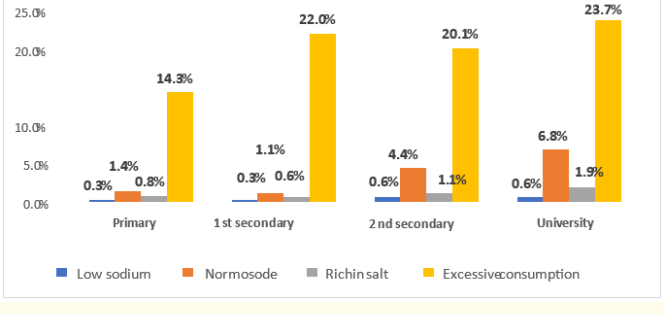

Figure 7: Distribution of patients according to sodium intake and level of education.

Low-salt diet, therapeutic compliance and blood pressure control

There was a significant association between blood pressure control and 24-hour natriuresis. On the other hand, there was no significant association between the Girerd test and 24-hour natriuresis. *Table IV* illustrates these findings.

Variables	n	N = 363 %
Doctor's speciality Cardiology	187	 51,5
Neurology	60	16,5
Endocrinology	44	12,1
Nephrology	32	8,8
Rheumatology	30	8,3
Geriatrics	2	0,6
Internal medicine	6	1,6
General medicine	2	0,6
Follow-up by a dietician Yes	12	 3,3
No	351	96,7
Classes of antihypertensives Calcium inhibitors	250	68,9
IEC	142	39,1
ARA2	58	16,0
Thiazide diuretics	114	31,1
Beta-blockers	19	5,2
Central antihypertensive agents	2	0,6

Table 4: Medical specialties of treating physicians and antihypertensive drugs in hypertensive patients.

Factors associated with adherence to a low-salt diet

The results in *table V* show a significant relationship between 24h natriuresis and BMI with a p-value < 0.001.

Discussion

Analysis of the methodology

This study is the first epidemiological investigation of compliance with a low-salt diet in a sample of Congolese hypertensive patients aged 30 and over. Our study took place in Brazzaville, the capital of the Congo, which is the country's largest city in terms of

	Natriuresis > 6g/d		Natriuresis < 6g/d		OR [95% CI]	P-value
Variables	n (%)		n (%)			
Gender						0,06
Female	223 (62,5)		6 (100)		-	
Male	134 (37,5)		0 (0,0)		-	
Age groups						0,8
30-45 years old	55 (15,4)		1 (16,7)			
46-59 years old	118 (33,1)		1 (16,7)			
60-75 years	151 (42,3)		3 (50,0)			
≥ 75 years	33 (9,2)		1 (16,7)			
Tobacco						0,7
No	347 (97,2)		6 (100)		-	
Yes	10 (2,8)		0 (0,0)		-	
Diabetes						0,6
No	265 (74,2)		5 (83,3)			
Yes	92 (25,8)		1 (16,7)			
BMI						<0,001
Insufficiency Pond	7 (2,0)		5 (83,3)		-	
Normal	118 (33,1)		1 (16,7)		-	
Overweight	112 (31,4)		0 (0,0)		-	
Obese	120 (33,6)		0 (0,0)		-	
AVC						0,8
No	274 (76,8)		6 (100)		-	
Yes	83 (23,2)		0 (0,0)		-	
Heart disease						0,04
No	323 (90,5)		5 (83,3)		Reference	
Yes	34 (9,5)		1 (16,7)		9,9 [2,3-41,08]	
Alcoholism						0,4
No	241 (67,5)		3 (50,0)			
Yes	116 (32,5)		3 (50,0)			
TOTAL(n)	357		6			

Table 5: Factors associated with natriuresis in hypertensive patients (N = 363).

surface area and population. The population is varied and representative of all socio-economic strata and all departments of the Congo. We included 363 patients suffering from hypertension, followed as outpatients in 3 main hospitals in Brazzaville. Individuals were invited to register on the study list, so this was not a random selection. Salt intake was assessed biologically using 24-hour Natriuresis. This is considered to reflect daily sodium intake. This technique is the reference in scientific studies for determining the daily amount of salt consumed [13,16,17]. However, it has a limitation with regard to the collection of 24-hour urine. These were outpatients, so although we explained to patients how to collect 24-hour urine, we do not know whether they followed the instructions.

Despite these limitations, we have obtained results that can be discussed in the light of the international literature.

Socio-demographic and clinical aspects

In our study, women predominated (61.6%) among hypertensive patients followed up as outpatients in Brazzaville, with a mean age of 60.9 ± 29.4 years. Our results contrast with those of previous studies on the profile of hypertensive patients in Brazzaville. In 2018, Ellenga Mbolla., *et al*. [7] found during a screening for hypertension in 3 cities in Congo (Pointe Noire, Brazzaville and Nkayi), a male predominance of nearly 61%, with a mean age of 30.9±14.7 years. Further on, in 2004 the data of Ellenga Mbolla et al. were found by Kimbally., *et al*. [6]. This difference in results could be explained by the methodology used in the last 2 studies. The earlier studies were carried out in the general population [6,42], while the Kimbally study used the WHO STEPS approach [6] and that of Ellenga Mbolla a screening in a non-hospital setting [7]. Our sample of hypertensive patients was obtained in the hospital setting; patients known to be hypertensive who consulted large hospital centres for the management of the multivisceral complications of hypertension. Thus, our results are similar to those of Ikama., *et al*. who in studying a sample of 1040 known hypertensive patients followed in private clinics in Brazzaville [23] reported a mean age of 53.8±9.7 years with a male predominance of only 53.4%. Our results are similar to those of Diop., *et al*. [24] in Senegal who found a mean age of 61.1 ± 10.9 years. Although black hypertensive patients are known to be young and predominantly male, our results show that black hypertensive patients consulting hospitals are more likely to be female and older. This contrast raises the question of awareness and management of hypertension, a genuine global public health problem. Younger patients do not feel concerned by this chronic condition, and will only consult a doctor after the disease has progressed for a long time. The patients in our study were more representative of the middle class with 61.2%, as found in other studies [6,7,25].

The most common level of education in our study was tertiary (33.1%). Our results differ from those of Koné., *et al*. [26] and Boré., *et al*. [27] where patients with no schooling are the most represented (51.8% and 34% respectively). Diop., *et al*. [24] in Senegal report a secondary education level of 36.1%.

Our results can be explained by the high level of schooling. [28] This is recognised in Congo Brazzaville compared with other sub-Saharan African countries [90], with access to school for all social strata.[28].

Salt consumption

Hypertensive patients followed as outpatients in Brazzaville do not adhere to the low-salt diet. Our results showed that a significant proportion of patients (80.2%) consumed excessive amounts of salt. Average salt consumption was high (21.9±16.7 g/d), while compliance with the low-salt diet was low (1.6%). Our results fall far short of the WHO recommendation of less than 6g of salt per day. Our data contrasts with those of other European and African studies. In Europe, the INCA-1 [29], INCA-2 [30] and SU-VI-MAX [5] found an average daily intake of 8.1 g, 7.7 g and 7.5 g respectively. In Africa Draoua., *et al*. [8] found an average of 8.73 g of salt per day in 162 hypertensive patients in Algeria. Boombhi., *et al*. [31] in Cameroon found an average of 7.7 g of salt/day in 148 hypertensive patients. All African studies report excessive salt consumption of more than 50% in hypertensive patients [8,31,32]. Draoua., *et al*. [8] reported a salt excess rate of 57.5%. This high proportion of salt consumption in hypertensive patients could be explained by

Firstly, the lack of nutritional or dietetic treatment. In fact, our work shows that dietary management is almost non-existent, and was only found in 3.3% of patients. A low-salt diet is the fourth measure recommended by the European Society of Hypertension (ESH) for the management of all hypertension [22]. This management must be specialised (nutritionist, dietician). Draoua., *et al*. also found a low proportion of dietary management of the order of 3.8%. [8]. A lack of knowledge about salt-rich foods could also explain these results. It has to be said that this lack of knowledge is reinforced by the absence of recommendations adapted to the local diet.

Finally, these results could also be explained by the lack of widespread awareness of the dangers of salt and the promotion of good eating habits. For example, few Congolese get into the habit of checking the labels on ultra-processed foods, which are generally known to be high in salt. The lowsalt diet is most often summed up as the absence of added table salt and sauces during meals. Furthermore, patients' lack of knowledge of the WHO-recommended target of less than 6g of salt per day and the failure of healthcare professionals to disseminate this information are obstacles to patients' compliance with the low-salt diet. Our study did not reveal that any of the hypertensive patients were aware of the target recommended by the WHO.

Although the high proportion of salt consumption found in our study is similar to that of other African authors [8,31]. The same cannot be said for the average. The average found in our study is 2 to 3 times higher than that found by other authors. This difference could be explained by the different methodologies used by the other authors. Draoua., *et al*. in Algeria used dietary survey methods [8] to assess dietary salt consumption. These methods are known to be prone to numerous errors, with a tendency to underestimate the daily amount of salt. Boombhi., *et al*. in Cameroon [31] relied on the determination of 24-hour natriuresis from urinary sodium and creatinine measured on a spot urine sample using a mathematical formula proposed by Tanaka., *et al*. [33]. This method avoids bias in the collection of 24-hour urine samples, which could lead to an overestimation of daily salt intake; the method used in our study. European studies which quantified sodium intake by natriuresis, as in our study, had lower mean values than those in our study [29,30,34]. This difference could be explained by the existence in these countries of programmes to raise awareness of the harmful effects of salt in the general population [35] the existence of treatment by specialists in nutrition [36] and the existence of therapeutic education programmes [37].

Although the high proportion of salt consumption found in our study is similar to that of other African authors [8,31]. The same cannot be said for the average. The average found in our study is 2 to 3 times higher than that found by other authors. This difference may be explained by the different methodologies used by other authors. Draoua., *et al*. in Algeria used dietary survey methods [8] to assess dietary salt consumption. These methods are known to be prone to numerous errors, with a tendency to underestimate the daily amount of salt. Boombhi., *et al*. [31] in Cameroon relied on the determination of 24h natriuresis from urinary sodium and creatinine measured on a spot urine sample using a mathematical formula proposed by Tanaka., *et al*. [33]. This method avoids bias in the collection of 24hour urine samples, which could lead to an overestimation of daily salt intake; the method used in our study.

Salt consumption and blood pressure control

The link between salt consumption and hypertension is well established [38]. Before the era of diuretics, salt was the only effective treatment for hypertension [38]. In our study, all patients with 24hour natriuresis < 6 g/d had good blood pressure control, with a significant difference compared with the uncontrolled group ($p < 0.001$). Erdem., *et al*. [39] in Turkey, Yaméogo., *et al*. [1] in Burkina Faso and other authors [31,32,40] also found a significant difference.

Factors associated with excessive salt consumption

Our study shows that the presence of heart disease ($p = 0.04$) and a normal BMI ($p < 0.001$) were associated with good compliance with the low-salt diet.

Heart disease causes the heart's pump function to fail (heart failure). One of the most effective treatments is to reduce the volume of circulating blood. The two most effective ways of doing this are loop diuretics and a salt-free or low-salt diet [41]. Patients with heart disease are therefore made aware beforehand of the dangers of a salty diet, even in the absence of arterial hypertension.

As far as BMI is concerned, there is a complex relationship between salt and obesity. On the one hand, salt can stimulate the appetite and encourage the consumption of high-calorie foods, which can contribute to weight gain. [42]. On the other hand, obesity can alter taste and sensitivity to salt, which can lead to higher salt consumption to compensate. [42]. In addition, obesity can increase the body's salt requirements, as fatty tissue retains more water and sodium than lean tissue [42]. Thus, from a pathophysiological point of view, obese patients are more likely to consume excessive amounts of salt, without actually salting it [42].

Our study also showed that all patients who complied with the low-salt diet had good or minimal compliance, although the association was not statistically significant ($p = 0.9$). Thus, compliance with prescribed medication does not guarantee compliance with the low-salt diet. Our results are similar to those of Lamranilaghrib., *et al*. [32] with a $p = 0.3$.

Conclusion

Our study shows that compliance with the low-salt diet is poor among hypertensive patients in Brazzaville, irrespective of the physician's speciality, age and level of education. The presence of heart disease and a normal BMI were associated with good compliance with the low-salt diet. It highlights the need to strengthen health education and communication strategies for behaviour change aimed at reducing salt consumption among hypertensive patients and healthcare professionals. It also suggests avenues of research

to identify the factors that facilitate or hinder compliance with the low-salt diet. Finally, it contributes to improving the quality of care and reducing the cardiovascular complications associated with hypertension.

Bibliography

1. Mesli MF., *et al*. "Factors associated with poor blood pressure control in 253 treated hypertensives". *Annales de Cardiologie et d'Angéiologie* 64.1 (2015): 32-38.

2. Mills KT., *et al*. "The global epidemiology of hypertension". *Nature Reviews Nephrology* 16.4 (2020): 223-37.

3. Denolle T., *et al*. "Recommendations on blood pressure measurement. Consensus d'experts de la Société française d'hypertension artérielle, filiale de la Société française de cardiologie". *La Presse Médicale* 48.11 (2019): 1319-1328.

4. Derouiche A., *et al*. "Assessment of daily salt intake in Moroccan adults". *Clinical Nutrition and Metabolism* 30.2 (2016): 110.

5. Enquête nationale sur les maladies non transmissibles STEPS [Internet]. Agence Nationale de la Statistique et de la Démographie (ANSD) du Sénégal (2023).

6. Kimbally-Kaky G., *et al*. "Prevalence of hypertension in Brazzaville". *Cardiac Troponins* 32.127 (2006): 43-46.

7. Ellenga-Mbolla B., *et al*. "May Measurement Month 2019: an analysis of blood pressure screening results from Republic of the Congo". *European Heart Journal* 23 (2015): B49-51.

8. Biostatistics Department. Faculté de Médecine d'Oran. Cabinet de Cardiologie Oran, Draoua I., *et al.* "Dietary survey of salt consumption in hypertensive subjects of Oran (Algeria) on 2014". *Nutrition and Santé* 04.02 (2016): 69-75.

9. Benefit assessment of salt reduction in patients with hypertension: systematic overview (2023).

10. Clinical and Metabolic Nutrition Laboratory (LNCM). Department of Biology, Faculty of Natural and Life Sciences. Université Oran1 Ahmed Ben Bella Oran, Algeria, Lamri- Senhadji M. The salt. What effects on cardiovascular health. Between controversy and polemic". *Nutrition and Santé* 07.02 (1996): 49-53.

11. Hannedouche T., *et al*. "Salt, hypertension and public health". *Nephrology and Therapeutics* 3 (2007): S99-103.

12. Frisoli TM., *et al*. "Salt and Hypertension: Is Salt Dietary Reduction Worth the Effort?" *The American Journal of Medicine* 125.5 (2012): 433-439.

13. Cardiologue libéral., *et al*. "Sodium intake and arterial hypertension". *Batna Journal of Medical Sciences* 2.1 (2015): 19-23.

14. Andrassy KM. "Comments on 'KDIGO 2012 clinical practice guideline for the evaluation and management of chronic kidney disease". *Kidney International* 84.3 (2013): 622-623.

15. Girerd X., *et al*. "Assessment of antihypertensive compliance using a self-administered questionnaire: development and use in a hypertension clinic". *La Presse médicale* 30.21 (2001): 1044-1048.

16. Girerd X., *et al*. "Development and evaluation of the ExSel Test to detect excessive salt consumption in hypertensive patients". *Annals of Cardiology and Aneiology* 64.3 (2015): 124-127.

17. Stamler J. "The INTERSALT Study: background, methods, findings, and implications". *The American Journal of Clinical Nutrition* 65.2 (1997): 626S-642S.

18. Benoit M., *et al*. "How to assess the quality of compliance?" *L'Encéphale* 35 (2009): S87-90.

19. Schlienger JL. "Practical clinical nutrition: In adults, children and the elderly". *Elsevier Health Sciences* (2018): 393.

20. Chobanian AV., *et al*. "Seventh report of the Joint National Committee on Prevention, Detection, Evaluation and treatment of High Blood Pressure (2015).

21. Mayer-Renaud M. "Le statut socio-économique: Construction d'un indice utile pour la gestion sociale". *Socsoc* 20.1 (2002): 47-59.

22. Visseren FLJ., *et al*. "2021 ESC Guidelines on cardiovascular disease prevention in clinical practice". *European Journal of Preventive Cardiology* 29.1 (2022): 5-115.

23. Ikama MS., *et al*. "Hypertension and level of control in Brazzaville (Congo): place du Holter tensionnel". *Annales de Cardiologie et d'Angéiologie* 64.2 (2015): 76-80.

24. DIOP M. "Etude de l'observance thérapeutique chez les patients hypertendus suivis en ambulatoire dans le service de cardiologie de l'hopital de la paix de Ziguinchor". *[Senegal]: Université Assane Seck de Ziguinchor* (2022).

25. Osafo C., *et al*. "Prevalence of Chronic Kidney Disease in Hypertensive Patients in Ghana". *Renal Failure* 33.4 (2011): 388-392.

26. Koné I. "Observance of the hygieno-dietary regime in hypertensive patients". *[Mali]: Université de Bamako* (2008).

27. Boré O. "Observance thérapeutique chez les patients hypertendus dans le service de cardiologie du centre de santé de référence de la commune III du district de Bamako". *[Mali]: Faculty of Medicine and Odontostomatology* (2023).

28. Ministère du Plan, de l'Aménagement du Territoire, de l'Intégration Économique et du NEPAD, Centre National de la Statistique et des Études Économiques, and, ORC Macro, Calverton, Maryland". *Enquête Démographique et Santé du Congo (EDSC-I)* (2006): 1-365.

29. Dubuisson C., *et al*. "Comparaison de deux enquêtes nationales de consommations alimentaires (INCA 1 1998/99 et Baromètre santé nutrition 2002) au regard de cinq objectifs alimentaires du Programme national nutrition santé". *Revue d'Épidémiologie et de Santé Publique* 54.1 (2006): 5-14.

30. Anses - Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail Etude individuelle nationale des consommations alimentaires 2 (INCA 2) 2006-07.

31. Boombhi J., *et al*. "Evaluation de l'adhérencve du rythme hyposodé par l'excrétion urinaire de sodium chez un groupe de patients à l'hopital général de Yaoundé". *Health Sciences and Disease* 18.3 (2017): 40-45.

32. Lamranilaghrib S., *et al*. "How to assess compliance with low-salt diet in hypertensive patients?" *Nephrology and Therapeutics* 12.5 (2016): 335.

33. Tanaka T., *et al*. "A simple method to estimate populational 24-h urinary sodium and potassium excretion using a casual urine specimen". *Journal of Human Hypertension* 16.2 (2002): 97-103.

34. Etude SU-VI-MAX. "Coordonnée par le Pr Hercberg, directeur de recherche INSERM, in AFSSA, Rapport sel: évaluation et recommandations (2015): 22-23.

35. Bachmann M., *et al*. "Salt and hypertension, Report of the experts of the Swiss Federal Food Commission (2004).

36. Loret-Vanhoutte E. "Nutritional management of the hypertensive patient" (2013).

37. Cesari C. "Therapeutic education programme for patients with pulmonary arterial hypertension at the Nice University Hospital competence centre in 2014: a continuous improvement approach (2014): 226.

38. Bachmann M and Keller U. "Salt and hypertension". *Forum Médical Suisse* 8.50 (2008).

39. Erdem Y., *et al*. "The relationship between hypertension and salt intake in Turkish population: SALTURK study". *Blood Pressure* 19.5 (2010): 313-318.

40. Mohammed AO. "Arterial hypertension and salt. [Morocco]: Sidi Mohammed Ben Abdellah University (2017).

41. Blacher J., *et al*. "Low-salt diet: why, how?" *Médecine des Maladies Métaboliques* 5.4 (2011): 414-419.

42. Faucher P., *et al*. "Undernutrition in the obese subject" (2017).